

4 NATURAL RESOURCES

Introduction

The Carvers Creek State Park study area contains rich natural resources unique to the Sandhills region. This area has been recognized by conservationists for containing one of the most distinctive and endangered ecosystems in North Carolina and the country. This ecosystem is home to numerous rare plants and animals rarely found outside of the Sandhills region. The Cape Fear River Section on the eastern edge of the study area has not been fully inventoried for this master plan, however the property is a wonderful natural resource.

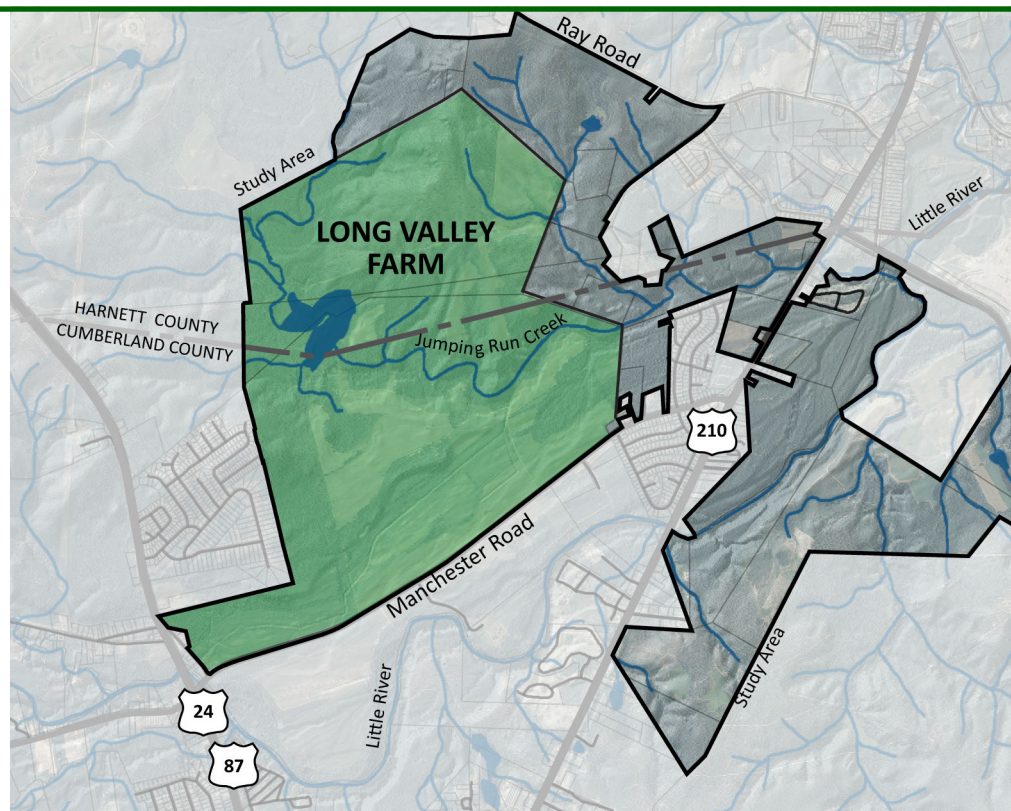
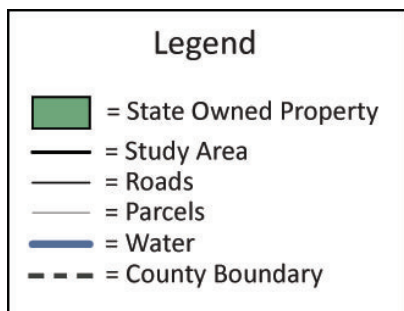
The Sandhills region is characterized by rolling topography and deep, sandy soils. Abundant creeks and dry sandy ridges have resulted in a large diversity of natural community types, with longleaf pine communities dominating the ridges and pocosin swamp and seepage communities found along the creeks. The study area contains diverse ecosystems: longleaf pine forests, mature mesic hardwood forests, blackwater streams, swamp forests, steep bluffs, and small waterfalls - a rare geomorphic feature for the region.

Geologists believe the advance and retreat of ancient oceans deposited sandy soils, and together with the clays deposited by erosion from the piedmont soils, the soils of the Sandhills region were formed. The present day rolling and sandy landscape was created by wind and water erosion.

The Cape Fear River flows along the southern edge of the Carvers Creek State Park study area. The area along the Cape Fear River contains two distinct regions: slopes and bluffs and the flat inner Coastal Plain. The slopes and bluffs region is located on the western side of the Cape Fear River. This area is characterized by entrenched creeks and banks reaching 100 feet high along the Cape Fear River and support communities which contain species more typically found in the mountains and piedmont. Waterfalls also occur in this area, especially along tributary creeks of the Cape Fear River.

The biodiversity of the Sandhills region depends on a combination of relatively high rainfall, sandy soils and an active cycle of wildfires. Longleaf pine forests are plant communities that adapted long ago to periodic burning, and their survival depends upon fire. The original forests were maintained by natural fires caused by lightning. As settlement and land development increased, the longleaf pine forests became increasingly fragmented. This fragmentation prohibited natural fires from running their course. Fire suppression by settlers in the area, continuing into the 20th century, also resulted in the decline of longleaf pine and biodiversity in this ecosystem. As a result, competing plant species thrived and inhibited the longleaf pine regeneration.

Controlled burns are fundamental to the ecological restoration and maintenance of longleaf pine ecosystems. Burning reduces the thickness of leaf litter, which allows for the establishment and germination of native species. Fire also returns beneficial nutrients to the soils, increasing soil fertility. Burning also controls invasive hardwood species.



Climate

The study area lies within the transition zone between the Coastal Plain and the Piedmont Plateau region of North Carolina. The subtropical climate of this region is known for high humidity and the absence of extreme winter temperatures. Average daily humidity varies from 85 percent at sunrise to 45 percent by early afternoon. The prevailing winds are southerly, except during periods of lower precipitation in October and November when winds shift to the north. Even during the driest months, the study area typically receives an average of more than 2.5 inches of precipitation per month (47.14 inches per year). Droughts typically occur in the region every three to five years. The average daily minimum temperature in January is 30 degrees Fahrenheit (F), while the average daily maximum temperature in July is 90 degrees F. The annual average maximum temperature is 73.4 degrees F and the annual average minimum temperature is 48.8 degrees F. Precipitation is decidedly greater during the summer and early fall. Thunderstorms are especially frequent in summer. Tropical storms and hurricanes that strike southeast coastal areas typically bring heavy rain. Winter storms can bring snow to the region with an average annual snowfall of 2.8 inches.

Aerial Map

Aerial data for Cumberland and Harnett counties was provided by The Nature Conservancy using Light Detection And Ranging (LIDAR) remote sensing data acquired in 2008. The aerial photography shows the study area, existing park parcels and how they relate to the current open space and development patterns occurring within the area. See Figure 4.1.

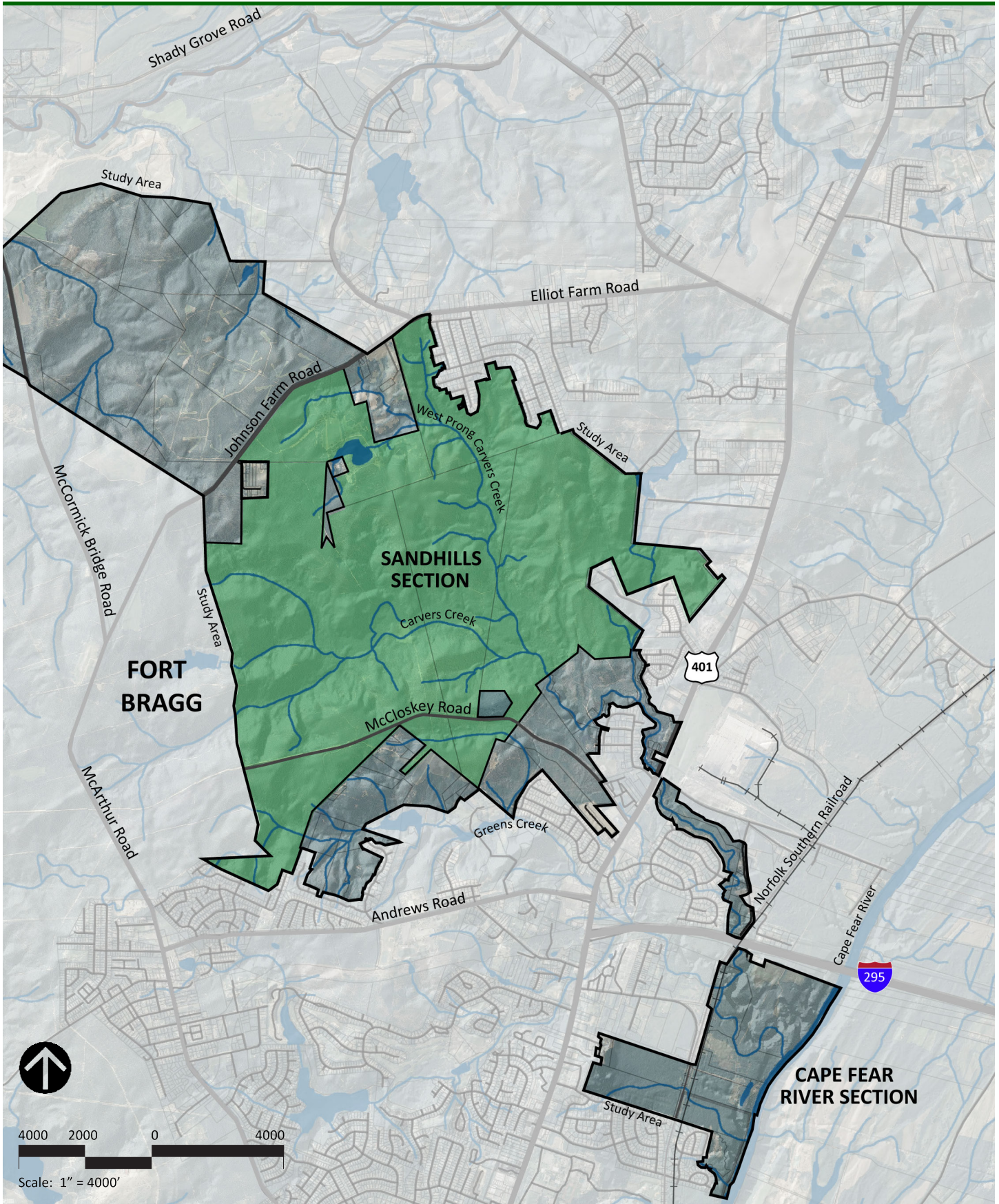
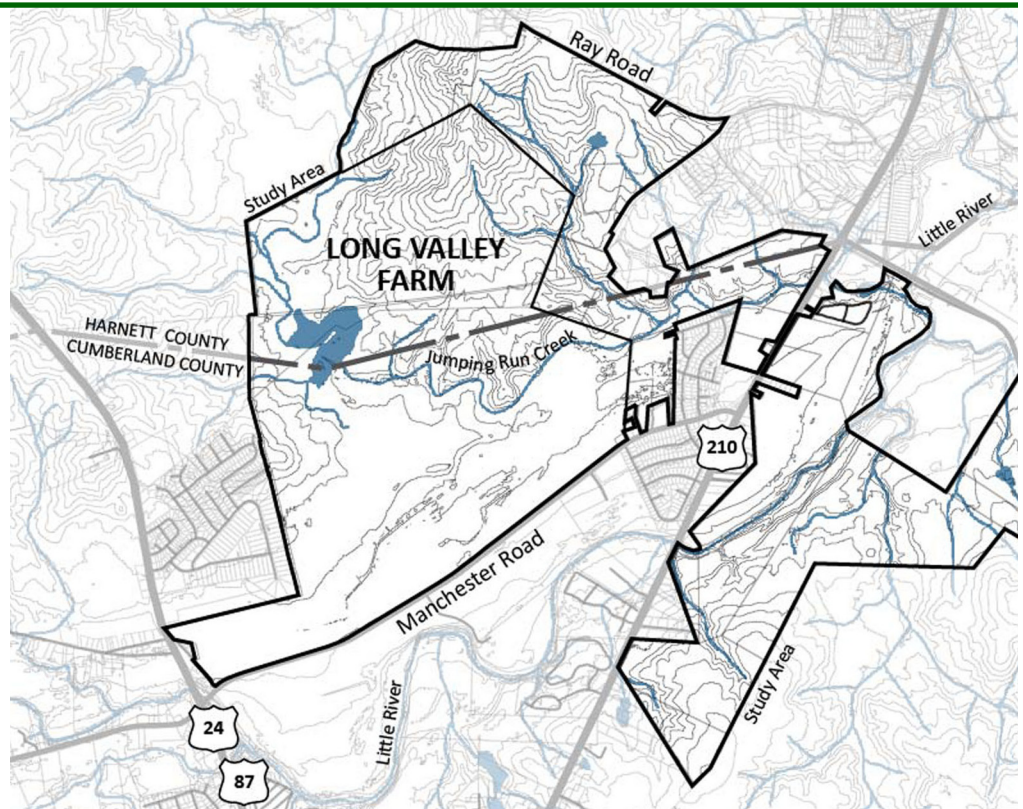
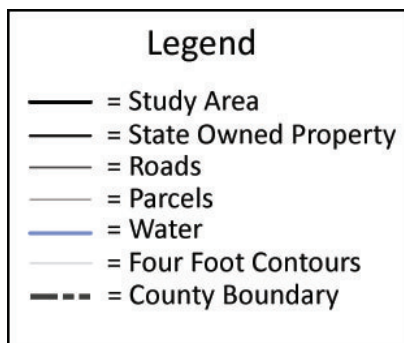


Figure 4.1 Aerial Map



Residential and commercial development within the study area can be seen primarily in the northern and southern portions, with the majority of the study area remaining as undeveloped woodlands and farm fields. Residential and commercial development in the northern area is adjacent to Long Valley Farm, in the Town of Spring Lake and in southern Harnett County. Development in the southern portion, adjacent to the Sandhills Section, is located to the northeast and south where it borders the municipal boundary of Fayetteville.

Topography

The study area includes more change in elevation than what is typically found in the Sandhills region of North Carolina, with a wide range of elevation change between the Long Valley Farm and the Cape Fear River Section. Long Valley Farm includes large areas of gentle slopes that have been used primarily for agricultural purposes. The Sandhills Section and Cape Fear River Section include steeper slopes. Figure 4.2 illustrates four-foot topographic contours for the study area. Contour data is based on 2007 LIDAR elevation data from the N.C. Department of Transportation.

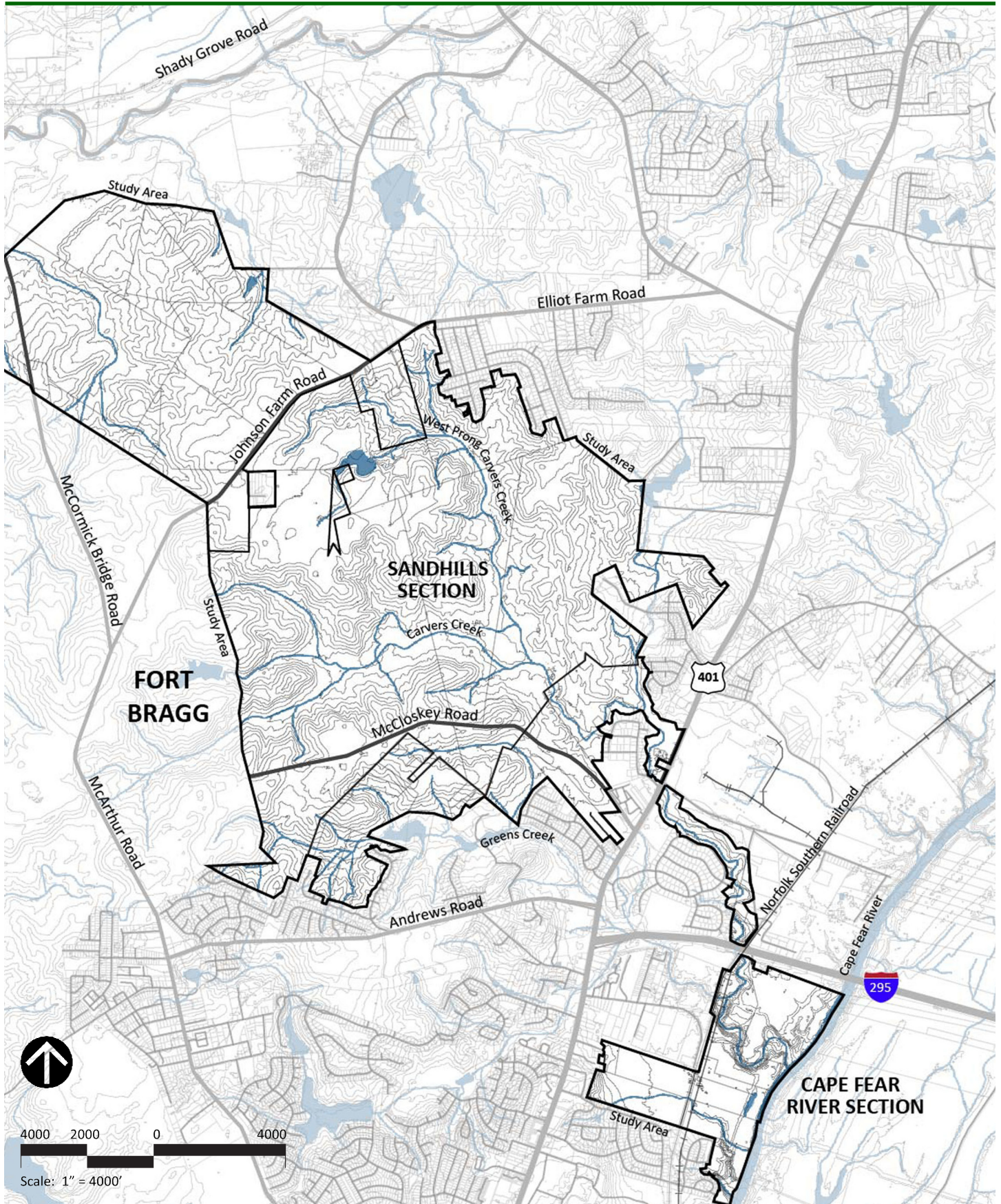
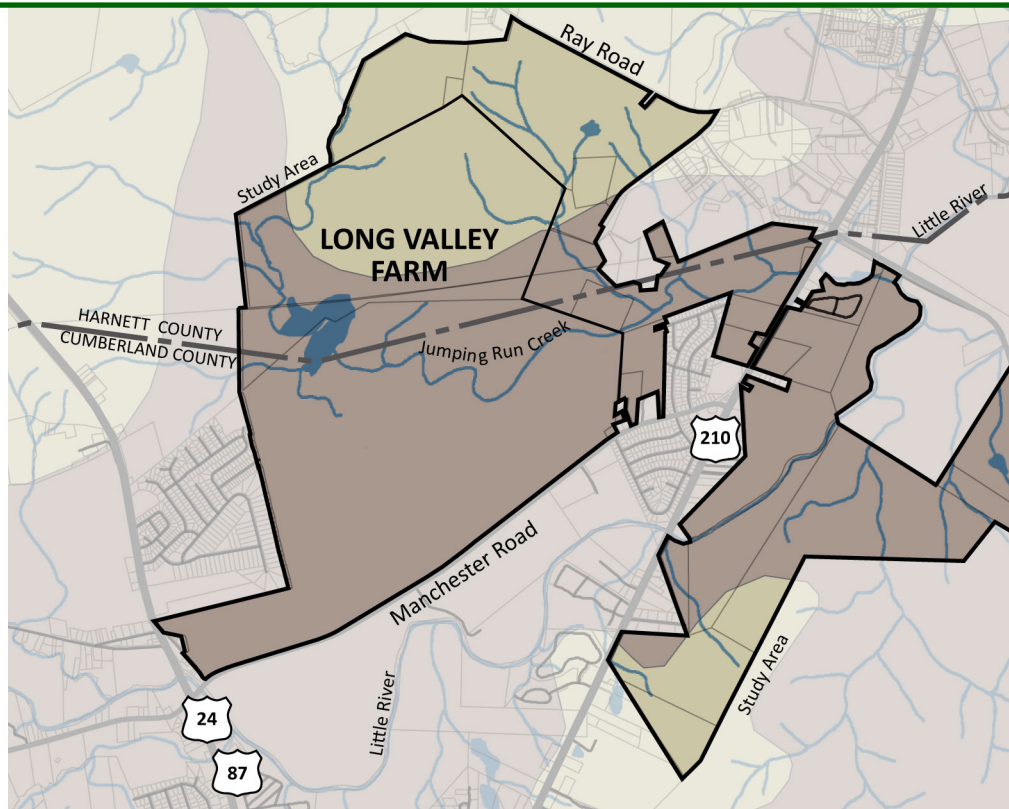


Figure 4.2 Topography Map



Geology

The Carvers Creek State Park study area consists of two major geologic formations; the Cape Fear Formation (Lower to Middle Cretaceous) and the Middendorf Formation (Upper Cretaceous). The Cape Fear Formation is characterized by sandstone and sandy mudstone which consists of interbedded clays and sands exposed along deeply entrenched rivers, such as the Cape Fear and Lower Little Rivers. Middendorf Formation includes fluvial-sands and clays commonly exposed on valley slopes and uplands in the Sandhills. Figure 4.3 illustrates the geology of the study area.

Bedrock in this area is composed of volcanic slate and is generally at depths of 200 to 400 feet below the surface. Overlying this bedrock are Cretaceous period sands and gravel attributed to the Lower Cape Fear and Upper Middendorf formations. Above the Cretaceous sands and gravels are Tertiary period sands on the eastern edge of the Sandhills. While sand is predominate throughout the Sandhills and rock outcrops are extremely rare, several sandstone outcrops occur on top of Middendorf beds, which are typically characterized by little soil development and sandstone occurring along narrow hilltops.

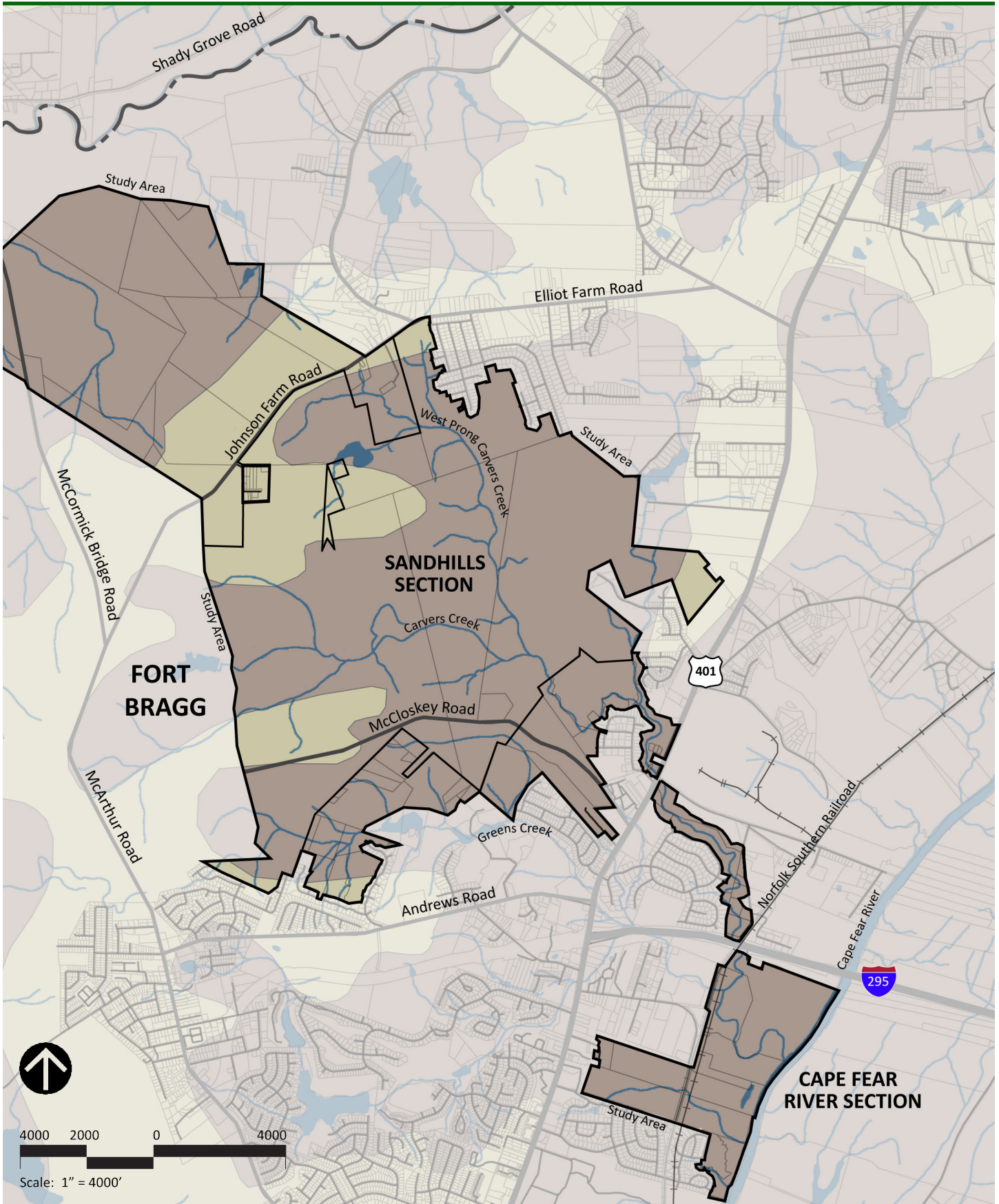
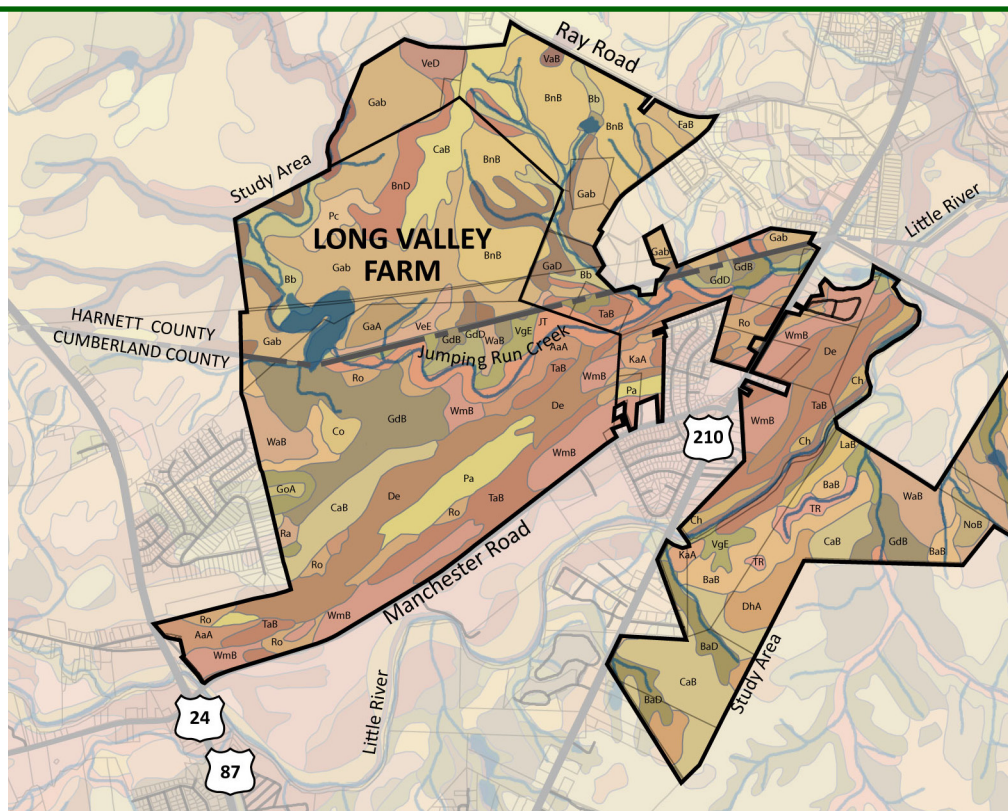
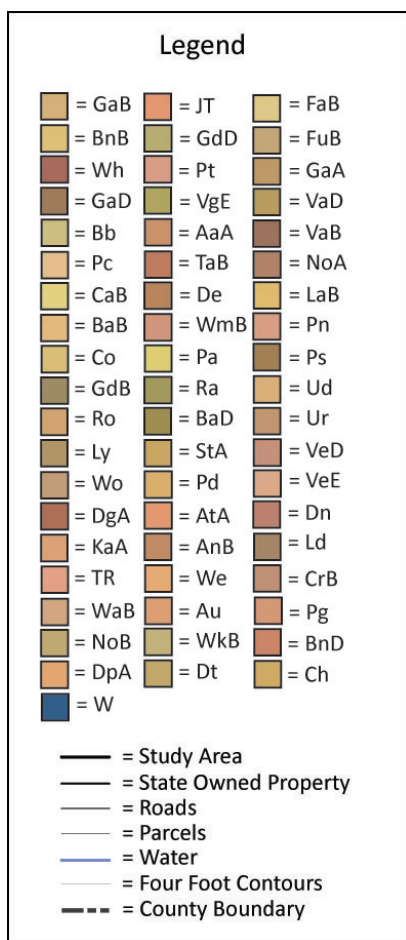


Figure 4.3 Geology Map



Soils

Carvers Creek State Park study area contains over 58 soil classifications. Soil type has a major influence on the suitability of development. The construction of roads, buildings, campsites, trails, and recreational facilities each require different levels of soil suitability.

The limiting characteristics of the soil types include erodibility, poor drainage, shallow water table depth, ponding, and flooding. Long Valley Farm contains some soils that are classified as potentially hydric and are unsuitable for development of structures, trails, camp areas, and picnic areas.

The Sandhills Section contains significant areas of hydric soils. These areas are located in the lower elevations and are associated with the existing waterbodies and floodplain. The location of these soils is significant for development in that they bisect the site from east to west, essentially dividing the Sandhills Section into two areas of potential development.

The limiting factors in the development of facilities and a recreational network in the Cape Fear River Section are due to the topography, slope, and potential high level of soil erodibility. Most of these erodible soils are located along the banks of Carvers Creek and its tributaries.

See Figure 4.4 for Soil Mapping of the study area. See Appendix C for more detailed soil descriptions. Soil data was provided by North Carolina Geographic Information Coordinating Council as well as the Natural Resource Conservation Service. More detailed soil investigations will be required during design and construction phases.

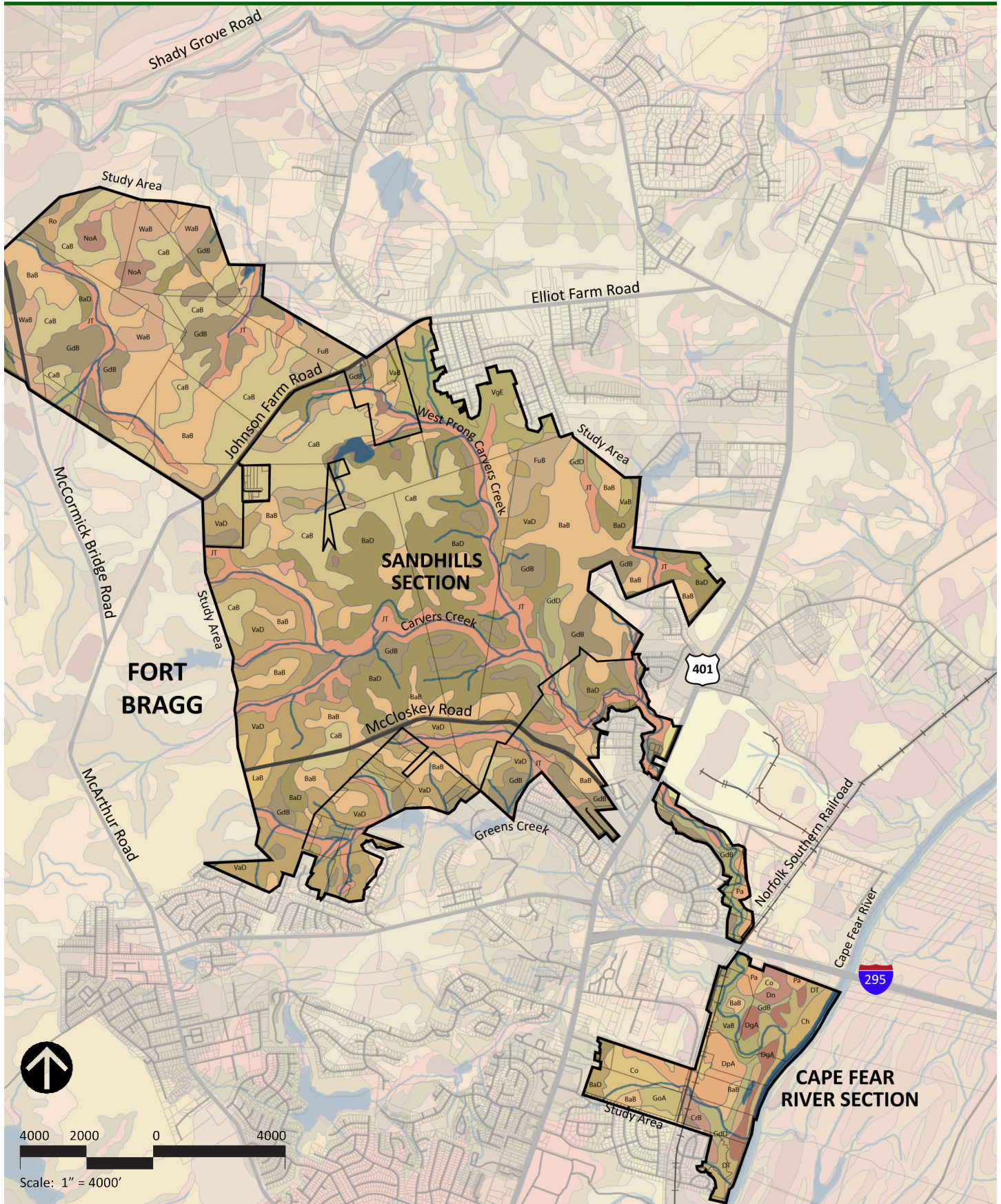
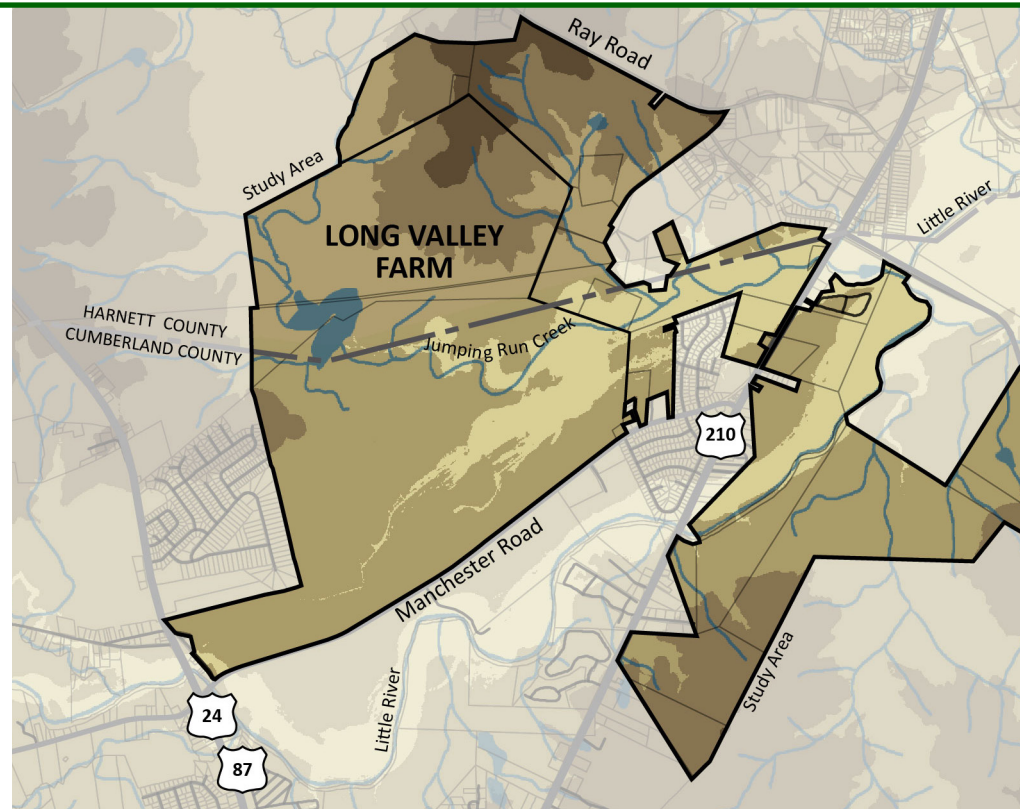
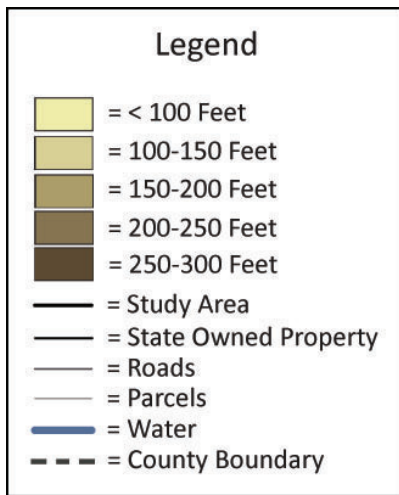


Figure 4.4 Soils Map



Elevation

Figure 4.5 illustrates the elevation levels within the Carvers Creek State Park study area. Elevation values range from a high point north of Long Valley Farm of approximately 280 feet above sea level, to a low point of 36 feet above sea level at the Cape Fear River. The elevations at Long Valley Farm range from 276 to 144 feet above sea level. The elevations at the Sandhills Section range from 256 to 124 feet above sea level. The elevations in the Cape Fear River Section range from 112 to 36 feet above sea level.

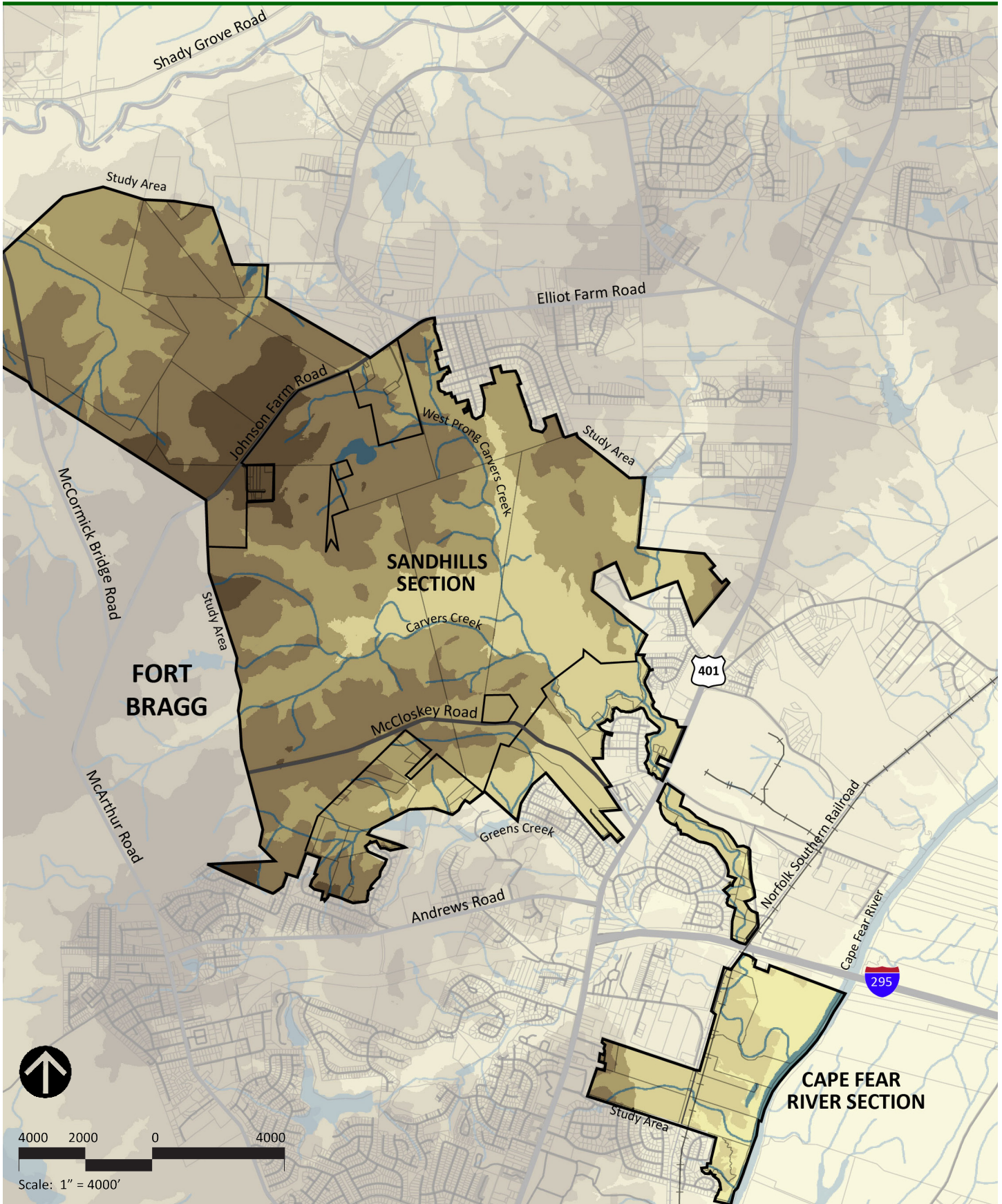
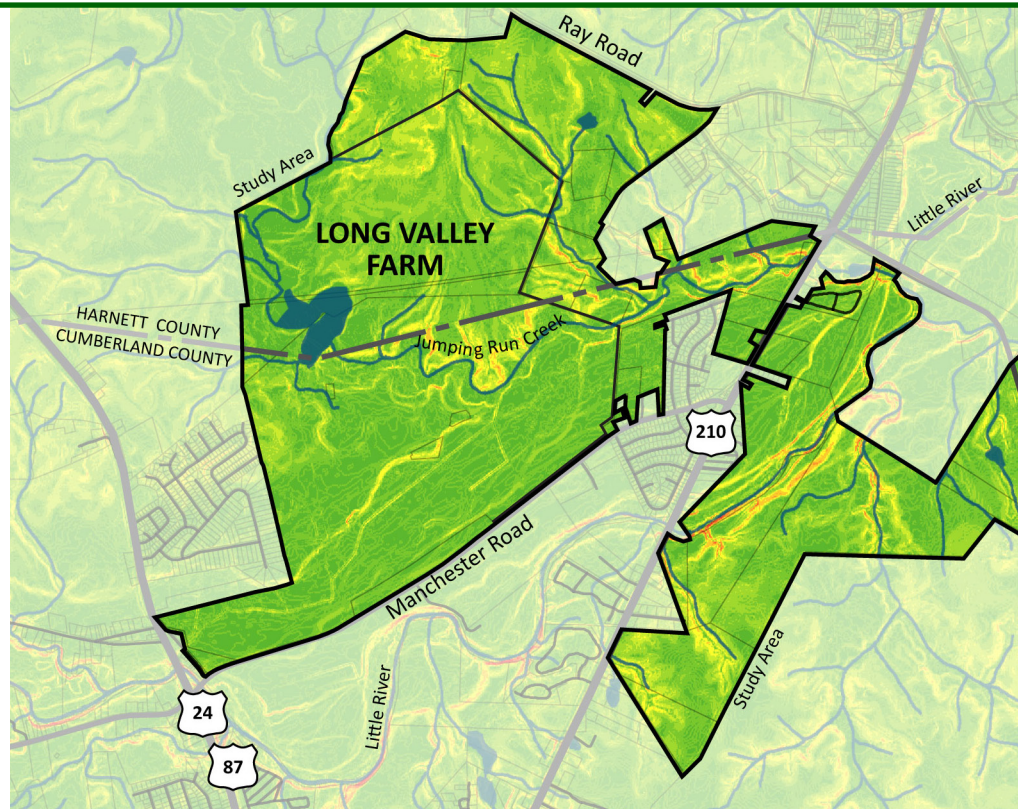
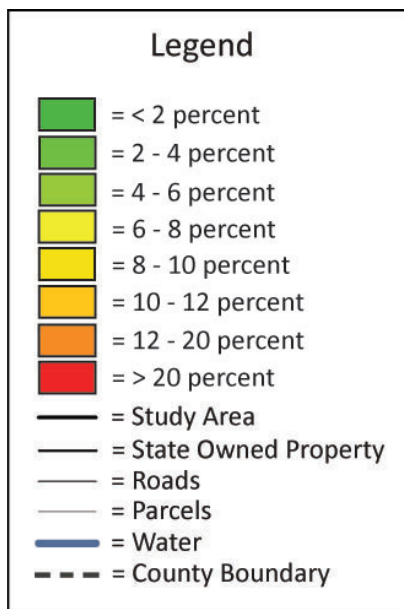


Figure 4.5 Elevation Map



Slope

The topography in the Carvers Creek State Park study area is varied from gently sloping agricultural land to rolling hills and steep bluffs. While most of the study area contains gentle slopes of less than 6 percent, there are areas, specifically along the Cape Fear River, where the slope exceeds 50 percent. Long Valley Farm, the Sandhills Section, and the Carvers Falls Section each exhibit different topography and visual character.

The majority of the land within Long Valley Farm is sloped at less than 4 percent. The majority of the land in the Sandhills Section is sloped less than 10 percent. Both the Sandhills and Cape Fear River Sections contain areas where slope exceeds 20 percent, specifically along creek banks.

Gentle slopes (between 0 to 6 percent) are shown on Figure 4.6, the slope analysis map, as varying shades of green. These slopes are typically found on former and current agricultural areas and are most suitable for development. Grading in these areas can occur without a high risk of erosion. Moderate slopes (6 to 10 percent) are represented on Figure 4.6 as shades of yellow. These slopes present somewhat limited development opportunities due to the potential erosion of sandy soils. Steep slopes (greater than 10 percent) are shown on Figure 4.6 as varying shades of red. These slopes are found primarily along creeks and drainage ways, and development in these areas should be very limited. The data for the slope analysis is based on LIDAR (Light Detection and Ranging) and does not represent survey quality data. Topographic surveys should be obtained during the site specific design of the properties.

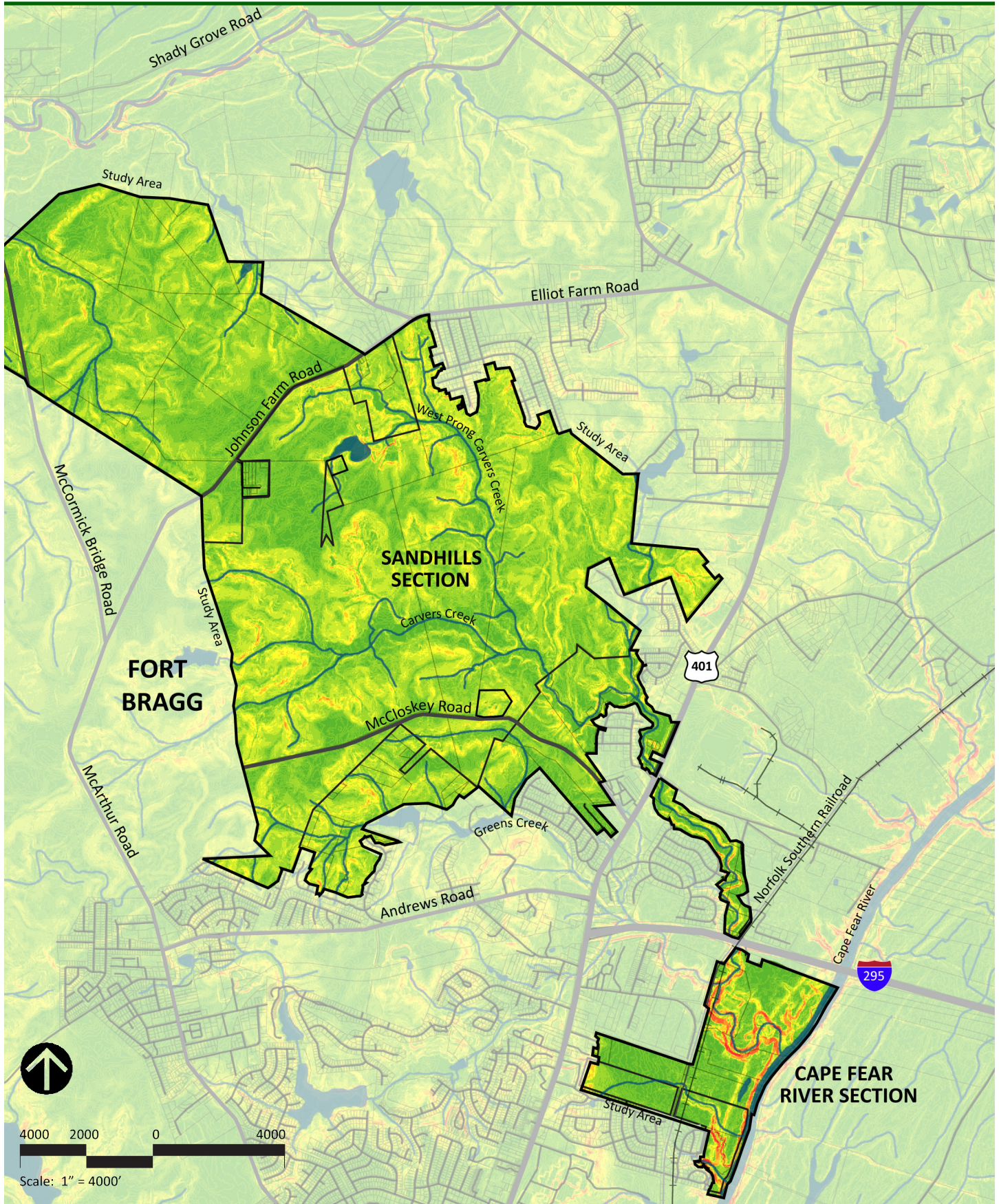
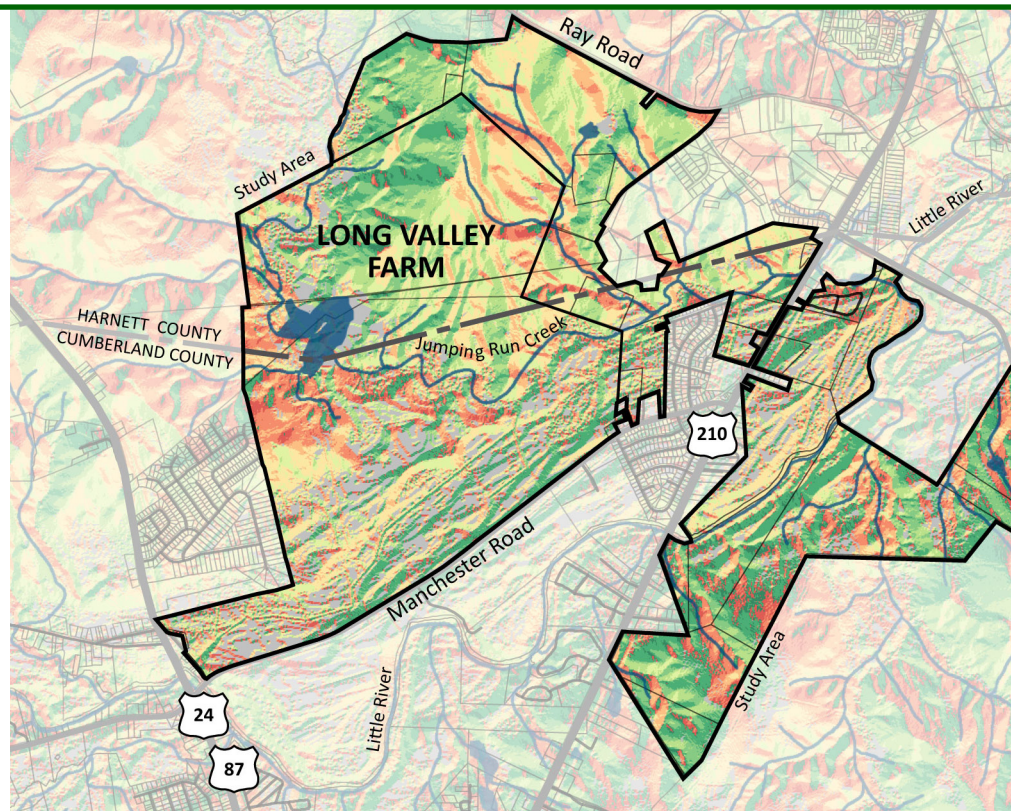
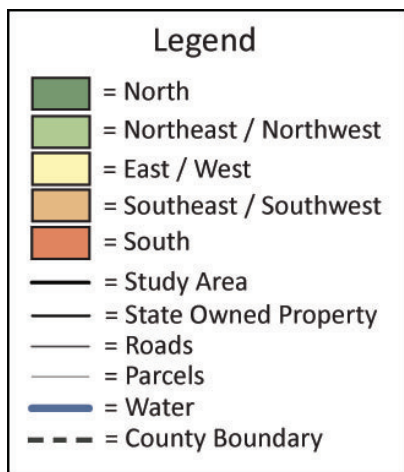


Figure 4.6 Slope Analysis Map



Aspect

The direction that land faces, or its aspect, has a large influence on ecological makeup, land management techniques, and potential for development. South and southwest facing slopes are generally drier, hotter, and have different biological communities than slopes that are facing north and northeast. This difference in microclimate also affects the land management techniques used. Prescribed burning plays a vital role in the health of the longleaf pine forest ecosystem. Prevailing winds, moisture levels, and vegetative communities influence the frequency and intensity of fire.

Aspect influences the type and site location of development. Designing public spaces and buildings in order to maximize year-round use and physical comfort is desirable. Development within the study area should include proper solar orientation of buildings for passive heating and cooling, natural daylighting, and ventilation. See Figure 4.7 for Aspect Analysis Map.

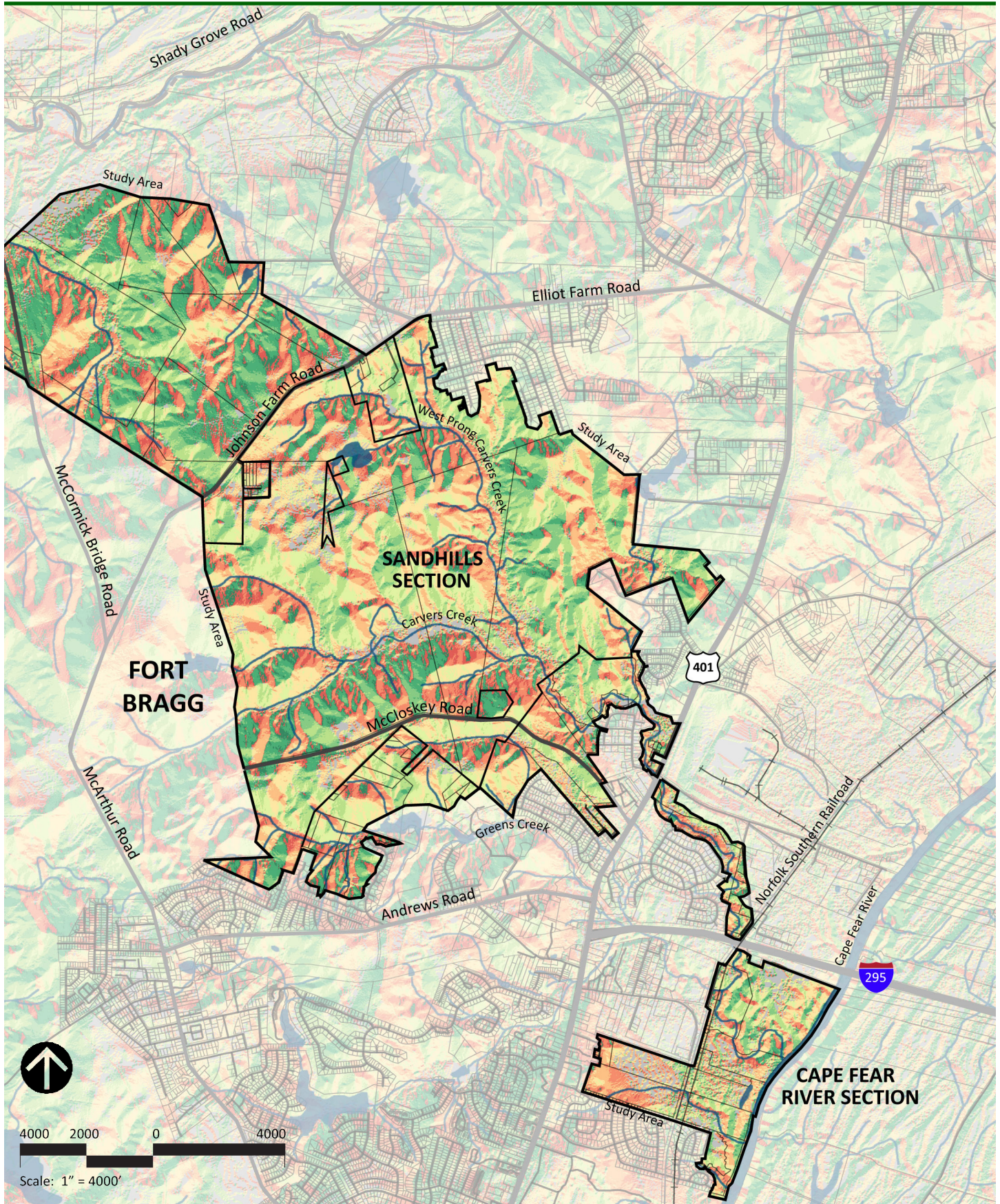
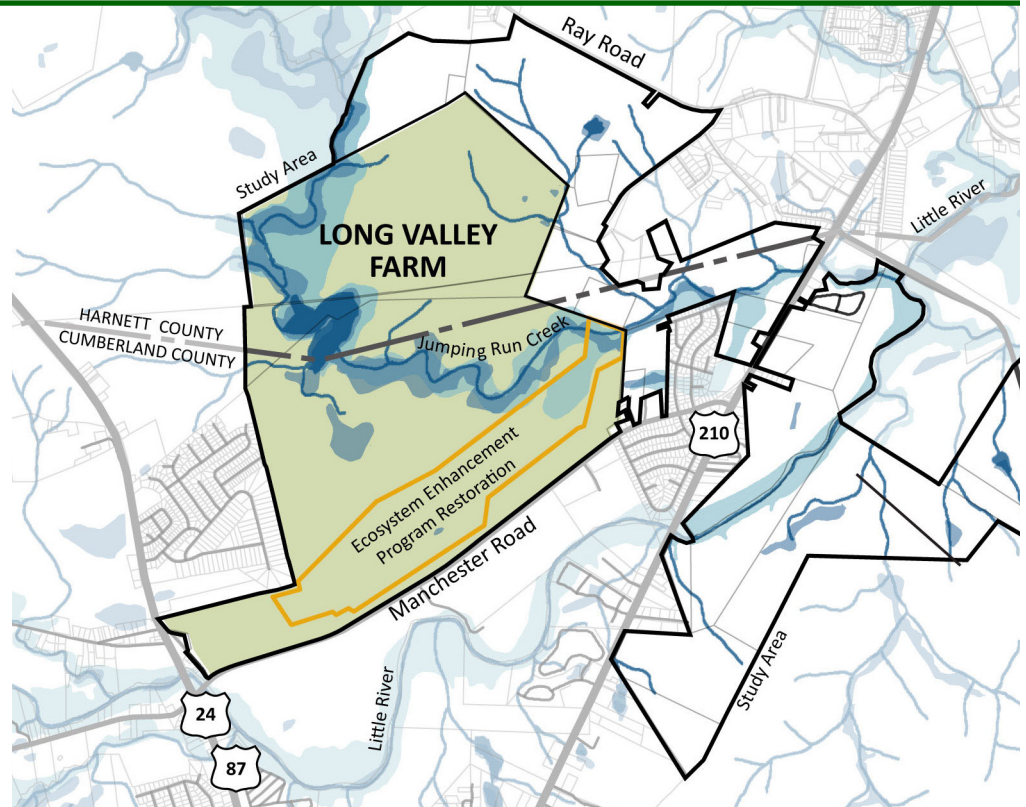


Figure 4.7 Aspect Analysis Map



Hydrology

The Carvers Creek State Park study area is located within the Cape Fear River Basin, see Figure 4.9. This watershed is the largest in the state, covering over 9,000 square miles. The study area is located within subbasin number 15. This subbasin measures 600 square miles and contains the city of Fayetteville as well as the majority of the Fort Bragg Military Reservation. The population of the Cape Fear River Basin is estimated to be 1,825,321 people, according to the 2000 census.

The Cape Fear River flows through the eastern portion of the subbasin, but most of the subbasin is made up of the Rock Creek and Little Rockfish Creek watersheds. The study area is located in the eastern central part of the subbasin. See Figure 4.8 for a map of the hydrology of the study area.

The Cape Fear River and its tributaries are an invaluable natural resource of North Carolina. It is the largest and most industrialized river basin in the state and has tributaries in 29 of the state's 100 counties. The Cape Fear River Basin extends from its headwaters north of Greensboro to the river's mouth in Southport and is about 200 miles in length. Twenty-seven percent of the state's population resides within the basin. The Cape Fear River provides freshwater for consumptive uses, routes for water transportation, various recreational opportunities, as well as critical wildlife and fisheries habitat.

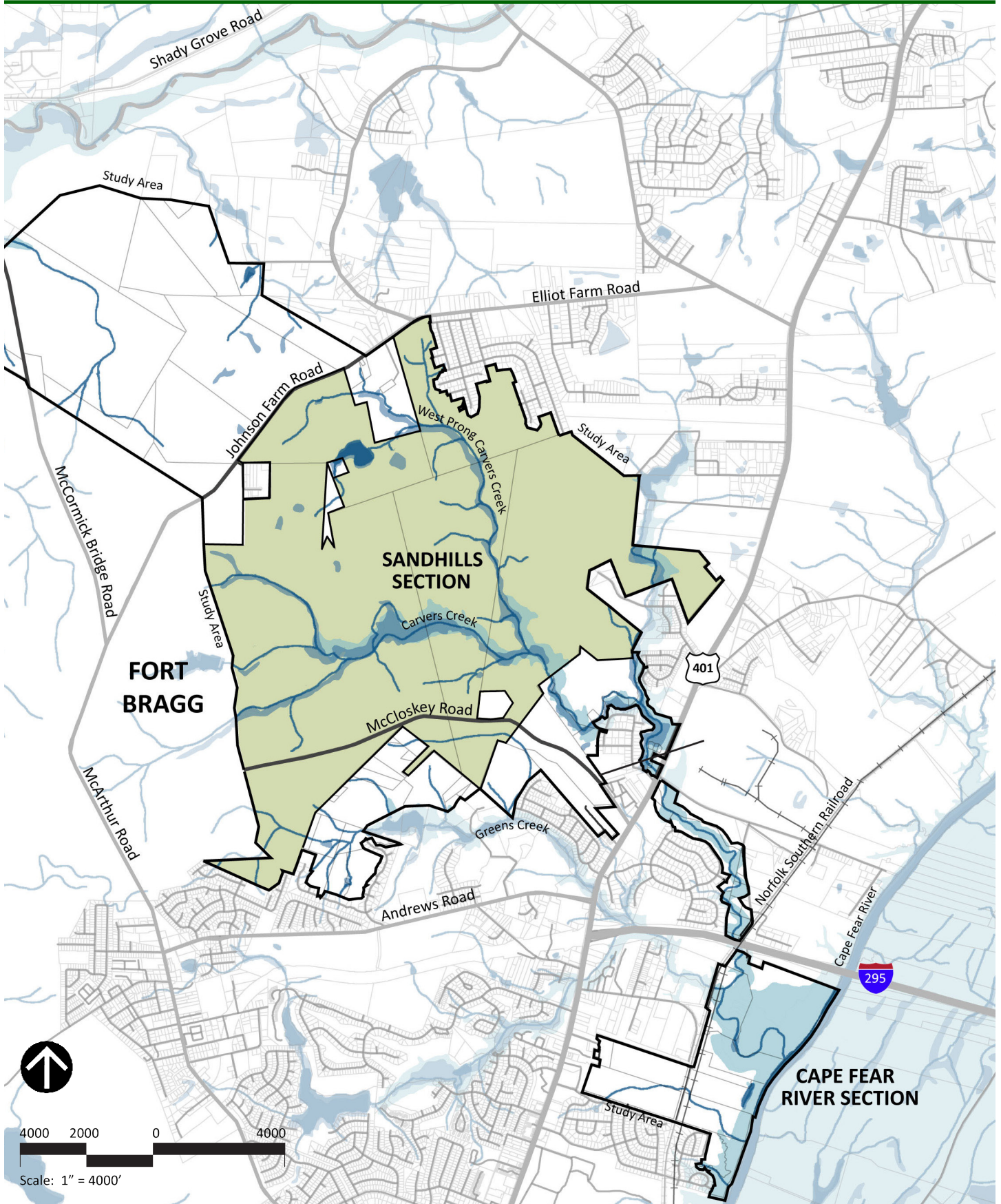


Figure 4.8 Hydrology Map

NORTH CAROLINA RIVER BASINS

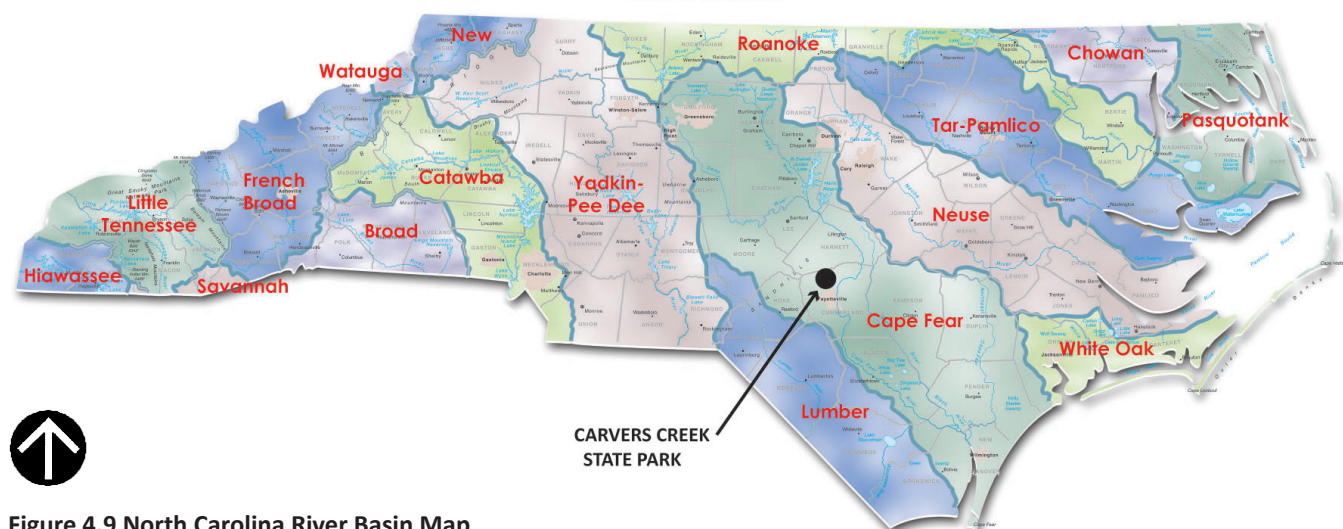


Figure 4.9 North Carolina River Basin Map

The creeks and rivers within the study area are classified as Class C and Water Supply-IV by the North Carolina Division of Water Quality. Class C includes waters that are protected for uses, such as secondary recreation, fishing, wildlife, fish consumption, aquatic life including propagation, survival and maintenance of biological integrity, and agriculture. Water Supply-IV are waters protected as sources of water supply for drinking, culinary, or food processing and are generally in moderately to highly developed watersheds or protected areas. One impaired waterbody lies within the study area: the Lower Little River, from the Fort Bragg lower water intake to the Cape Fear River.

The study area is bisected by several creeks, streams, and rivers of various sizes which eventually drain into the Cape Fear River. The Little River bisects the northern region of the study area. Water bodies within Long Valley Farm drain into the Little River. The Little River eventually meets with the Cape Fear River along the Harnett and Cumberland county line to the east of the study area.

Long Valley Farm

Creeks in the Long Valley Farm property drain primarily from northwest to southeast. One main creek, several smaller creeks, one impounded pond, and several small farming ponds are located on Long Valley Farm. Jumping Run Creek is a black water creek that flows through the property. It flows from Harnett County into McDiarmid Millpond in the northwestern portion of the property and exits along the eastern edge of the parcel in Cumberland County. Numerous unnamed creeks join Jumping Run Creek as it flows into the Little River.

The North Carolina Ecosystem Enhancement Program (EEP) completed a stream restoration of an unnamed tributary in the southern portion of Long Valley Farm in 2010. This project restored 7,057 linear feet and 96 acres of riparian and non-riparian wetlands and enhanced 1,935 linear feet of stream

and 3.4 acres of riparian wetlands, which is a Coastal Plain Small Stream Swamp system. Wetland restoration of the agricultural fields involved raising the local water table and restoring the natural flooding patterns. The existing stream channel was restored to a stable condition and wetland functions were restored on the adjacent hydric soils.

Sandhills Section

Four creeks are located within the Sandhills Section: Carvers Creek, West Prong of Carvers Creek, North Prong of Carvers Creek and Greens Creek. The flow of these creeks are primarily to the south/southeast. Numerous unnamed creeks are located within this property. The creeks flow to the southeast corner of the property where they are impounded by an earthen dam. The damming of these creeks results in large areas of backwater swamps. The confluence of Carvers Creek, North Prong, and West Prong Carvers Creek occurs outside of the Sandhills Section before they meet with the Cape Fear River.

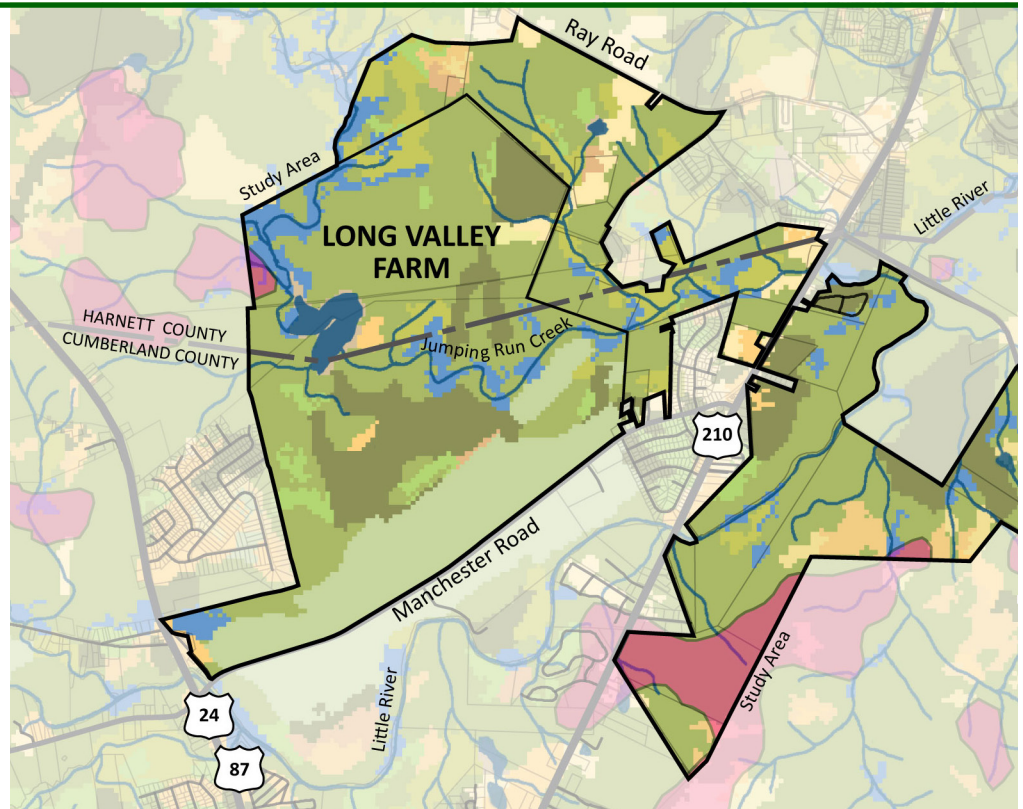
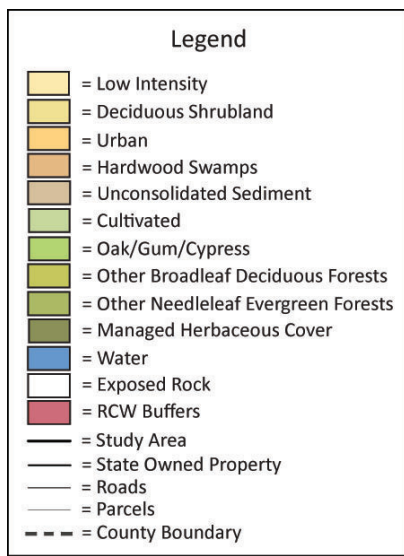
The study area includes a significant amount of land within the 100-year floodplain. The 100-year floodplain is defined as an area of land that has a 1 percent probability of experiencing a flood any given year. These areas are mapped on Flood Insurance Rate Maps by the Federal Emergency Management Agency. Floodplains are defined as low lands that adjoin surface water. The 100-year floodplain in Long Valley Farm surrounds Jumping Run Creek and McDiarmid Millpond. The 100-year floodplain in the Sandhills Section surrounds Carvers Creek, North Fork Carvers Creek and West Prong Carvers Creek. The 100-year floodplain in the Cape Fear River Section surrounds Carvers Creek and its tributaries.

Carvers Falls Section

There are two main creeks in the Carvers Falls Section, Carvers Creek and McPherson Creek. The confluence of these two creeks occurs in the central portion near Carvers Falls. Carvers Creek then flows to the south and east to its confluence with the Cape Fear River.

Mapping of the wetlands is based on the National Wetlands Inventory. Wetlands provide many ecological, economic, and social benefits. They provide habitat for fish, wildlife and plants, hold and slowly release flood water, recharge groundwater, act as filters to clean runoff, recycle nutrients, and provide recreation and wildlife viewing opportunities. Numerous wetlands are located in the study area, mapped by the National Wetlands Inventory. There may also be wetlands present that are not mapped. Wetland delineation and survey for specific areas is recommended for the property at the time of site design.

Any surface water, including wetlands, found in the state park fall under the jurisdiction of the U.S. Army Corps of Engineers and the N.C. Division of Water Quality. Development within floodplain and wetlands will be avoided or will require permitting. Appropriate buffers will be determined to minimize impact, and wetlands and buffers will be avoided as much as possible.



Landcover - Flora and Fauna

The Sandhills region is among the most diverse botanical regions anywhere on the planet. There are several high quality natural communities throughout the study area as well as within Long Valley Farm, Sandhills Section, and the Cape Fear River Section. See figure 4.10 for a land cover map of the study area.

There are seven high quality natural communities within Long Valley Farm including Pine/Scrub Oak Sandhill, Xeric Sandhill Scrub, Sandhill Seep, Streamhead Pocosin, Coastal Plain Small Stream Swamp and Coastal Plain Semi Impoundment. The following birds are typically found in the longleaf pine forests here: Red-shouldered Hawk, American Kestrel, Red-cockaded Woodpecker, Red-headed and Red-bellied Woodpeckers, Brown-headed Nuthatch, Pine Warbler, and Chipping Sparrow. Eastern box turtle, northern spring peeper, eastern tiger swallowtail, northern black racer, and eastern fox squirrel can also be found here.

In addition to agricultural and pasture land, there are some specific plants and trees that are worth noting. Native species such as yellow pitcherplant, pinebarren sandreed, and Loomis's loosestrife are located on the property. At the Rockefeller House, there are several magnolias, camellias, azaleas, dogwoods, and hollies of possible historic significance. The old pear tree and wisteria are rumored to have been planted by Robert Wall Christian. There are two live oaks that were brought to the property by Mrs. Rockefeller from her family home in Cumberland County, Georgia.

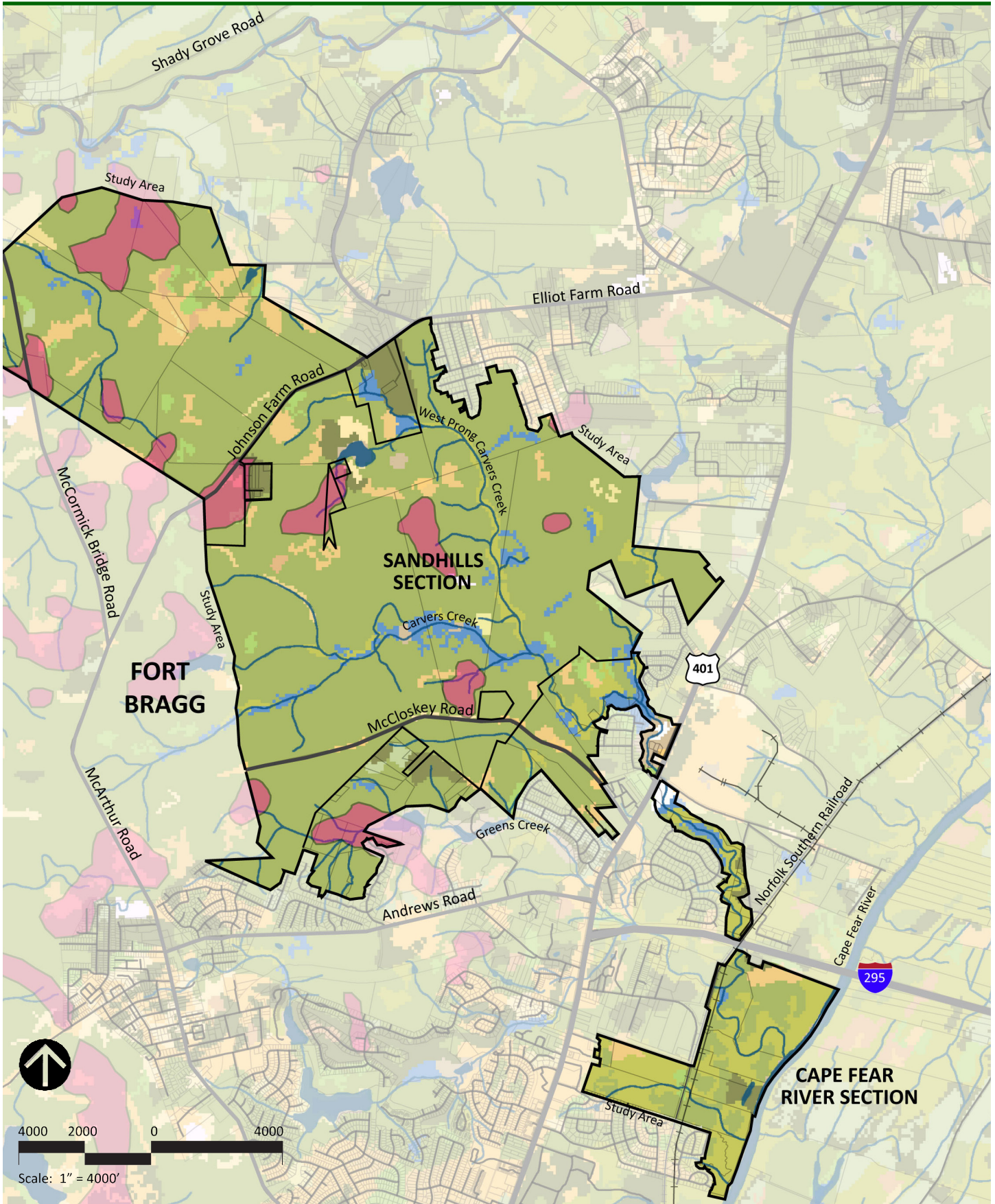
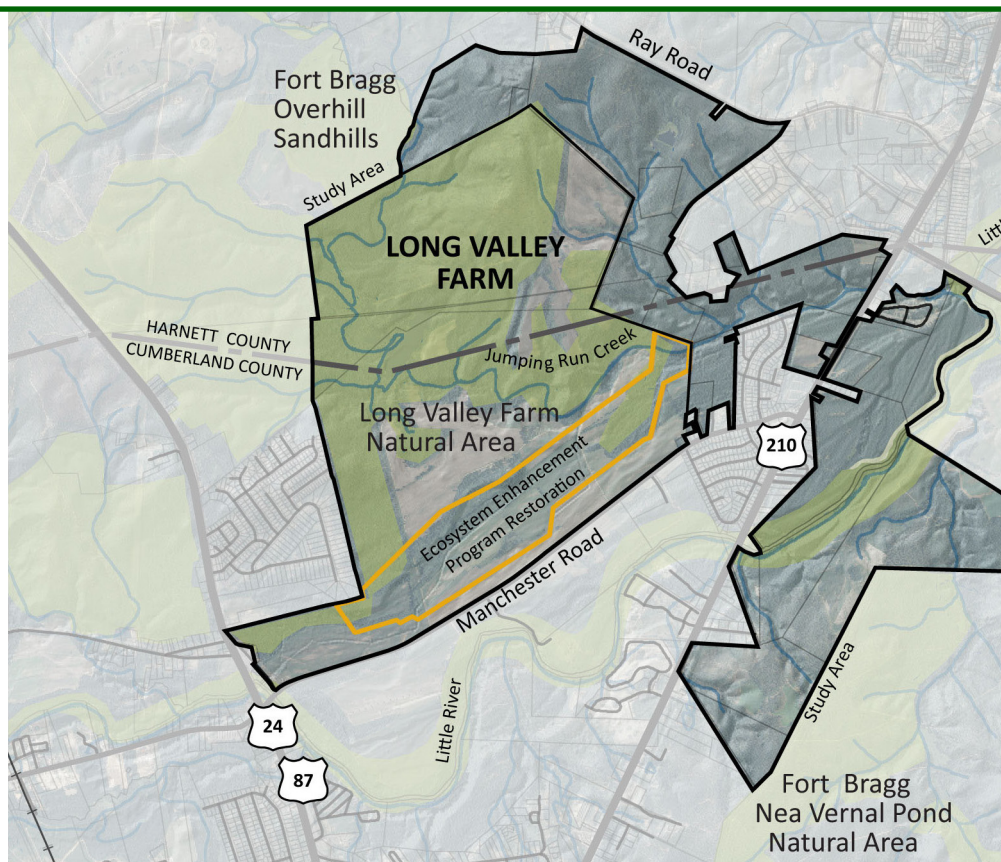
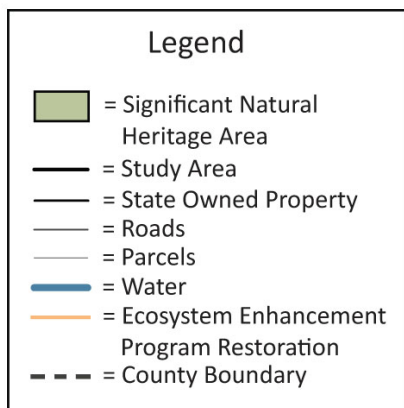


Figure 4.10 Landcover Map



The North Carolina Ecosystem Enhancement Program (EEP) restoration project will restore a Coastal Plain Small Stream Swamp system at Long Valley Farm, which will rejuvenate native flora and fauna.

The Sandhills Section also contains high quality natural communities including Xeric Sandhill Scrub, Pine/Scrub Oak Sandhill, Dry Oak-Hickory Forest, Mesic/Wet Pine Flatwoods, Streamhead Pocosin, Cypress-Gum Swamp Sandhills Seep and Coastal Plain Small Stream Swamp (blackwater subtype) and Coastal Plain Semi-Permanent Impoundment. The park contains 15 special status species including Red-cockaded Woodpecker, Sandhills pyxie-moss, Canby's bulrush, bog oatgrass, and eastern fox squirrel. Common birds of this property include Brown-headed Nuthatch, Summer Tanager, Pine Warbler, Carolina Wren, Eastern Towhee, Mourning Dove, and Bachman's Sparrow. Other animals of interest include pine barrens treefrog, dwarf waterdog, sawcheek darter, yucca giant-skipper, confused cloudywing, elfin skimmer, southeastern spinyleg, southern flying squirrel, eastern red bat, northern scarlet snake, and eastern cottonmouth. See Figure 4.12 for Carvers Creek State Park study area special status plant and animal species.

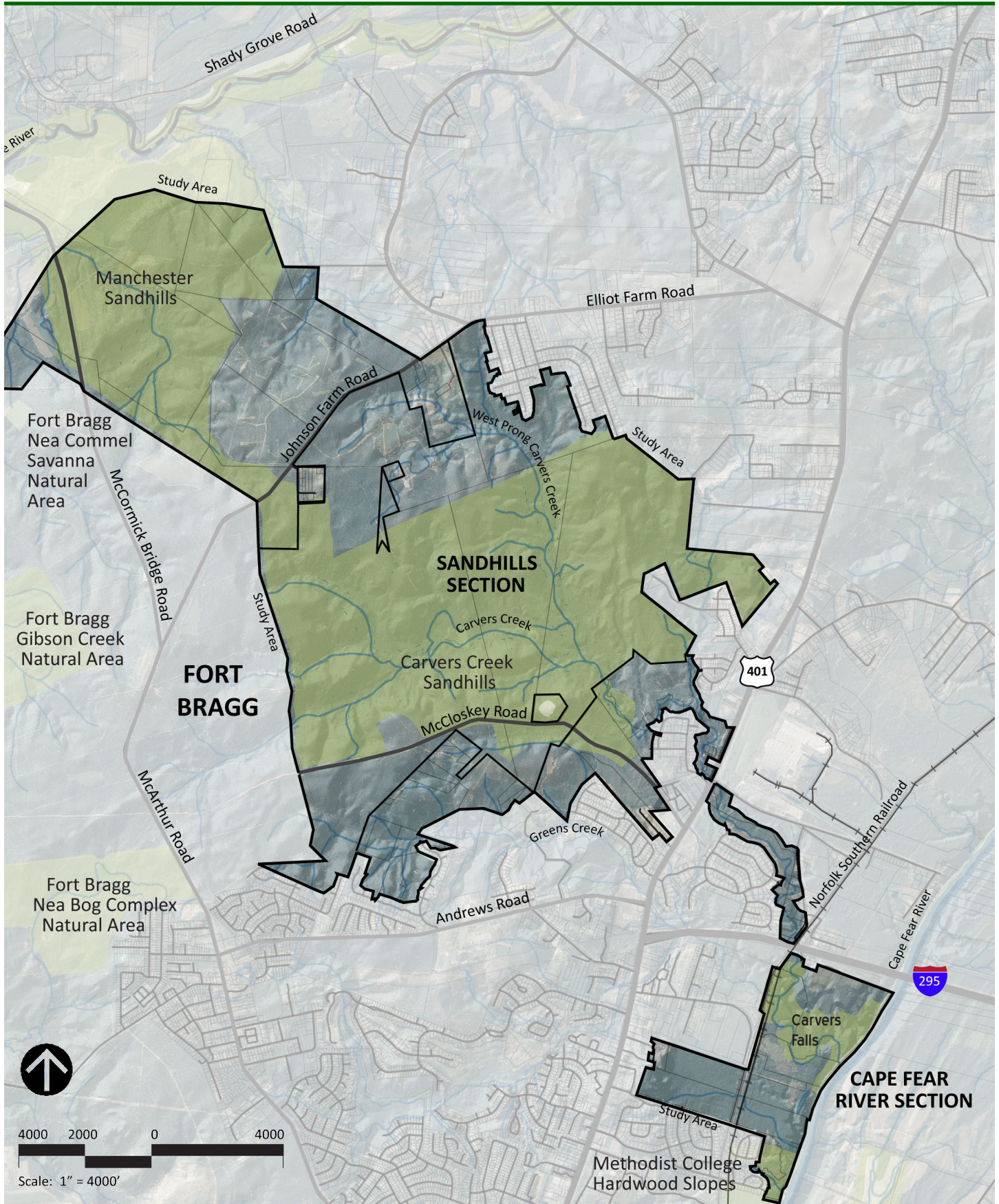


Figure 4.11 Significant Natural Heritage Areas Map

SPECIAL STATUS PLANT SPECIES

Bog Oatgrass	<i>Danthonia epilis</i>	SR-T	FSC
Bog Spicebush	<i>Lindera subcoriacea</i>	T	FSC
Canby's Bullrush	<i>Schoenoplectus etuberculatus</i>	SR-P	-
Cuthbert's Turtlehead	<i>Chelone cuthbertii</i>	SR-L	FSC
Lady Lupine	<i>Lupinus villosus</i>	SR-P	-
Sandhills Pyxie-moss	<i>Pyxidanthra brevifolia</i>	E	FSC
Sarvis Holly	<i>Ilex amelanchier</i>	SR-P	-

SPECIAL STATUS ANIMAL SPECIES

Bachman's Sparrow	<i>Aimophila aestivalis</i>	SC	FSC
Eastern Fox Squirrel	<i>Sciurus niger</i>	SR-G	-
Edward's Hairstreak	<i>Satyrium edwardsii</i>	SR	-
Frosted Elfin	<i>Callophrys irus</i>	SR	-
Hessel's Hairstreak	<i>Callophrys hesseli</i>	SR	-
Pine Barrens Treefrog	<i>Hyla andersonii</i>	SR	-
Red-cockaded Woodpecker	<i>Picoides borealis</i>	E	E
Reversed Roadside-skipper	<i>Amblyscirtes reversa</i>	SR	-

HIGH QUALITY NATURAL COMMUNITIES

Coastal Plain Semi-permanent Impoundment
Coastal Plain Small Stream Swamp (Blackwater Subtype)
Cypress-Gum Swamp (Blackwater Subtype)
Dry Oak-Hickory Forest
Mesic Pine Flatwoods (Coastal Plain Subtype)
Mesic Pine Flatwoods (Coastal Plain Variant)
Pine/Scrub Oak Sandhill
Sandhill Seep
Streamhead Pocosin
Xeric Sandhill Scrub (Sand Barren Variant)

Notes:

State Status: E - Endangered; T - Threatened; SC - Special Concern; SR - Significantly Rare

SR Designations: G - Game Animal; L - Limited (endemic or nearly so); P - Peripherally; T - Throughout its range

Federal Status: E - Endangered; FSC - Federal Species of Concern

Figure 4.12 Carvers Creek State Park Plant and Animal Species

Significant Natural Heritage Areas

Several Significant Natural Heritage Areas containing ecologically significant natural communities or rare species are documented in the region. The six Significant Natural Heritage Areas identified in the study area are: Long Valley Farm, Carvers Falls, Methodist College Hardwood Slopes, Manchester Sandhills, Carvers Creek Sandhills, and the Fort Bragg Overhills Sandhills. See Figure 4.11 for Significant Natural Heritage Areas.

Longleaf Pine Ecosystem

Only 3 percent of the historic longleaf pine wiregrass ecosystem remains today within the United States. Fort Bragg and surrounding areas contain over 160,000 acres of the longleaf pine ecosystem.

The longleaf pine wiregrass ecosystem is dependent on natural disturbance in order to maintain its biodiversity and habitat health. Fire is the primary disturbance agent. Part of the management plan to maintain the health of this

ecosystem is to incorporate controlled burning. This burning allows for the thinning of the understory to accommodate the regeneration of the longleaf pine and other plants in this community. This prescribed burning mimics the natural disturbance process.

Non-native and invasive species also pose a risk to the health of the longleaf pine ecosystem, and invasive species control programs will be implemented in the park to address these issues. The spread of non-native and invasive plants, both naturally and by humans, can cause a loss of biodiversity, soil erosion, and sensitive species habitat loss, resulting in degradation of the entire ecosystem.